

What is claimed is:

- Sub
G1
1. A protein comprising CRAF1 truncated by from about 323 to about 414 amino acid residues at the amino terminus, or a variant thereof capable of inhibiting CD40-mediated cell activation.
2. The protein of claim 1, wherein the variant comprises a conservative amino acid substitution.
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3. The protein of claim 1, wherein the CRAF1 is mouse CRAF1.
- Sub G1
- 15 4. The protein of claim 1, wherein the CRAF1 is human CRAF1.
5. A method of inhibiting activation by CD40 ligand of cells expressing CD40 on the cell surface, comprising providing the cells with an agent capable of inhibiting CD40-mediated intracellular signaling, the agent being present in an amount effective to inhibit activation of the cells.
- 20 Sub D1
6. The method of claim 5, wherein the agent is the protein of claim 1.
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7. The method of claim 6, wherein the cells are provided with the protein by introducing into the cells a nucleic acid sequence encoding the protein under conditions such that the cells express an amount of the protein effective to inhibit activation of the cells.
- 30 Sub D2
8. The method of claim 7, wherein the nucleic acid sequence is operably linked to a transcriptional control sequence recognized by the cell.
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9. The method of claim 7, wherein the nucleic acid sequence is a plasmid.
- 5 10. The method of claim 5, wherein the agent is a small molecule.
11. The method of claim 5, wherein the agent is modified from a lead inhibitory agent.
- 10 12. The method of claim 5, wherein the agent specifically binds to CD40 intracellular domain.
- 15 13. The method of claim 5, wherein the CD40-bearing cells are selected from the group consisting of B cells, fibroblasts, endothelial cells, epithelial cells, T cells, basophils, macrophages, Reed-Steinberg cells, dendritic cells, renal cells, and smooth muscle cells.
- 20 14. The method of claim 13, wherein the B cells are resting B cells, primed B cells, myeloma cells, lymphocytic leukemia B cells, or B lymphoma cells.
- 25 15. The method of claim 5, wherein the epithelial cells are keratinocytes.
16. The method of claim 5, wherein the fibroblasts are synovial membrane fibroblasts, dermal fibroblasts, pulmonary fibroblasts, or liver fibroblasts.
- 30 17. The method of claim 5, wherein the renal cells are selected from the group consisting of glomerular endothelial cells, mesangial cells, distal tubule cells, proximal tubule cells, parietal epithelial cells, visceral epithelial cells, cells of a Henle limb, and interstitial inflammatory cells.
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18. The method of claim 16, wherein the parietal epithelial cells are crescent parietal epithelial cells.

5 19. The method of claim 5, wherein the smooth muscle cells are smooth muscle cells of the bladder, vascular smooth muscle cells, aortic smooth muscle cells, coronary smooth muscle cells, pulmonary smooth muscle cells, or gastrointestinal smooth muscle cells.

10 20. The method of claim 19, wherein the gastrointestinal smooth muscle cells are esophageal smooth muscle cells, stomachic smooth muscle cells, smooth muscle cells of the small intestine, or smooth muscle cells of the large intestine.

15 21. A method of providing a subject with an amount of the protein of claim 1 effective to inhibit activation by CD40 ligand of cells bearing CD40 on the cell surface in the subject, comprising:
20 introducing into CD40-bearing cells of the subject, a nucleic acid sequence encoding the protein of claim 1, under conditions such that
25 the cells express in the subject an activation inhibiting effective amount of the protein.

30 22. The method of claim 21, wherein the introducing of the nucleic acid into cells of the subject comprises:
a) treating cells of the subject ex vivo to insert the nucleic acid sequence into the cells; and
b) introducing the cells from step a) into
35 the subject.

23. The method of claim 22, wherein the subject is a

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ls, coronary smooth muscle cells, pulmonary smooth muscle cells, or gastrointestinal smooth muscle cells.

method of claim 31, wherein the smooth muscle cells are esophageal smooth muscle cells, stomachic smooth muscle cells, or smooth muscle cells of the small intestine or smooth muscle cells of the large intestine.

method of treating a condition characterized by an aberrant or unwanted level of CD40-mediated intracellular signaling, in a subject, comprising providing the subject with a therapeutic amount of an agent capable of inhibiting CD40-mediated intracellular signaling in the presence of CD40 on the cell surface.

method of claim 33, wherein the agent is a protein of claim 1.

method of claim 34, wherein the protein is provided by introducing into CD40-bearing cells of a subject, a nucleic acid sequence encoding the protein under conditions such that the cells express the protein according to the method of claim 21.

method of claim 33, wherein the agent is a small molecule.

method of claim 33, wherein the molecule is derived from a lead inhibitory agent.

method of claim 33, wherein the condition is an allergic rejection in a subject receiving transplanted organs, or an immune response in a subject receiving a transplant.

- 5 32. The method of claim 31, wherein the
gastrointestinal smooth muscle cells are esophageal
smooth muscle cells, stomachic smooth muscle cells,
smooth muscle cells of the small intestine, or
smooth muscle cells of the large intestine.
- 10 33. A method of treating a condition characterized by
an aberrant or unwanted level of CD40-mediated
intracellular signaling, in a subject, comprising
providing the subject with a therapeutically
effective amount of an agent capable of inhibiting
CD40-mediated intracellular signaling in cells
bearing CD40 on the cell surface.
- 15 34. The method of claim 33 wherein the agent is the
protein of claim 1.
- 20 35. The method of claim 34, wherein the protein is
provided by introducing into CD40-bearing cells of
the subject, a nucleic acid sequence encoding the
protein under conditions such that the cells
express the protein according to the method of
claim 21.
- 25 36. The method of claim 33, wherein the agent is a
small molecule.
- 30 37. The method of claim 33, wherein the molecule is
modified from a lead inhibitory agent.
- 35 38. The method of claim 33, wherein the condition is
organ rejection in a subject receiving transplant
organs, or an immune response in a subject

receiving gene therapy.

39. The method of claim 38, wherein the transplant organ is a kidney, heart or liver.
40. The method of claim 33, wherein the condition is a CD40-dependent immune response.
41. The method of claim 40, wherein the CD40-dependent immune response is an autoimmune response in a subject suffering from an autoimmune disease.
42. The method of claim 41, wherein the autoimmune disease comprises rheumatoid arthritis, Myasthenia gravis, systemic lupus erythematosus, Graves' disease, idiopathic thrombocytopenia purpura, hemolytic anemia, diabetes mellitus, a drug-induced autoimmune disease, psoriasis, or hyper IgE syndrome.
43. A method of claim 42, wherein the drug-induced autoimmune disease is drug-induced lupus.
44. The method of claim 40, wherein the immune response comprises induction of CD23, CD80 upregulation, rescue from CD95-mediated apoptosis, rescue from apoptosis in a subject undergoing chemotherapy against a tumor, or autoimmune manifestations of an infectious disease.
45. The method of claim 44, wherein the autoimmune manifestations are derived from Reiter's syndrome, spondyloarthritis, Lyme disease, HIV infections, syphilis or tuberculosis.
46. The method of claim 33, wherein the condition is an allergic response.

47. A method of claim 46, wherein the allergic response is hay fever or a penicillin allergy.
- 5 48. The method of claim 33, wherein the condition is dependent on CD40 ligand-induced activation of fibroblast cells.
- 10 49. The method of claim 48, wherein the condition is selected from the group consisting of arthritis, scleroderma, and fibrosis.
- 15 50. The method of claim 49, wherein the arthritis is rheumatoid arthritis, non-rheumatoid inflammatory arthritis, arthritis associated with Lyme disease, or osteoarthritis.
- 20 51. The method of claim 49, wherein the fibrosis is pulmonary fibrosis, hypersensitivity pulmonary fibrosis, or a pneumoconiosis.
- 25 52. The method of claim 51, wherein the pulmonary fibrosis is pulmonary fibrosis secondary to adult respiratory distress syndrome, drug-induced pulmonary fibrosis, idiopathic pulmonary fibrosis, or hypersensitivity pneumonitis.
- 30 53. The method of claim 51, wherein the pneumoconiosis is asbestosis, siliconosis, or Farmer's lung.
- 35 54. The method of claim 49, wherein the fibrosis is a fibrotic disease of the liver or lung.
55. The method of claim 54, wherein the fibrotic disease of the lung is caused by rheumatoid arthritis or scleroderma.
56. The method of claim 54, wherein the fibrotic

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disease of the liver is selected from the group consisting of:

Hepatitis-C;

Hepatitis-B;

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cirrhosis;

cirrhosis of the liver secondary to a toxic insult;

cirrhosis of the liver secondary to drugs;

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cirrhosis of the liver secondary to a viral infection; and

cirrhosis of the liver secondary to an autoimmune disease.

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57. The method of claim 56, wherein the toxic insult is alcohol consumption.

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58. The method of claim 56, wherein the viral infection is Hepatitis B, Hepatitis C, or hepatitis non-B non-C.

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59. The method of claim 56, wherein the autoimmune disease is primary biliary cirrhosis, or Lupoid hepatitis.

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60. The method of claim 33, wherein the condition is dependent on CD40 ligand-induced activation of endothelial cells.

61. The method of claim 60, wherein the condition is selected from the group consisting of atherosclerosis, reperfusion injury, allograft rejection, organ rejection, and chronic inflammatory autoimmune diseases.

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62. The method of claim 61, wherein the atherosclerosis is accelerated atherosclerosis associated with organ transplantation.

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63. The method of claim 61, wherein the chronic inflammatory autoimmune disease is vasculitis, rheumatoid arthritis, scleroderma, or multiple sclerosis.

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64. The method of claim 33, wherein the condition is dependent on CD40 ligand-induced activation of epithelial cells.

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65. The method of claim 64 wherein the epithelial cells are keratinocytes, and the condition is psoriasis.

66. The method of claim 33, wherein the condition is an inflammatory kidney disease.

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67. The method of claim 66, wherein the inflammatory kidney disease is not initiated by autoantibody deposition in kidney.

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68. The method of claim 66, wherein the kidney disease is selected from the group consisting of:

membranous glomerulonephritis;
minimal change disease/acute tubular necrosis;
pauci-immune glomerulonephritis;
25 focal segmental glomerulosclerosis;
interstitial nephritis;
antitissue antibody-induced glomerular injury;
circulating immune-complex disease;
a glomerulopathy associated with a multisystem
30 disease; and
drug-induced glomerular disease.

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69. The method of claim 68, wherein the antitissue antibody-induced glomerular injury is anti-basement
35 membrane antibody disease.

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70. The method of claim 68, wherein the circulating

immune-complex disease is selected from the group consisting of:

infective endocarditis;

leprosy;

syphilis;

hepatitis B;

malaria; and

a disease associated with an endogenous antigen.

71. The method of claim 70, wherein the endogenous antigen is DNA, thyroglobulin, an autologous immunoglobulin, erythrocyte stroma, a renal tubule antigen, a tumor-specific antigen, or a tumor-associated antigen.

72. The method of claim 68 wherein the glomerulopathy associated with a multisystem disease is selected from the group consisting of:

diabetic nephropathy;

systemic lupus erythematosus;

Goodpasture's disease;

Henoch-Schönlein purpura;

polyarteritis;

Wegener's granulomatosis;

cryoglobulinemia;

multiple myeloma;

Waldenström's macroglobulinemia; and

amyloidosis.

73. The method of claim 68, wherein the pauci-immune glomerulonephritis is ANCA+ pauci-immune glomerulonephritis, or Wegener's granulomatosis.

74. The method of claim 68, wherein the interstitial nephritis is drug-induced interstitial nephritis.

75. The method of claim 66 wherein the kidney disease affects renal tubules.
76. The method of claim 75, wherein the kidney disease which affects renal tubules is selected from the group consisting of:
- a kidney disease associated with a toxin;
 - a neoplasia;
 - hypersensitivity nephropathy;
 - Sjögren's syndrome; and
 - AIDS.
77. The method of claim 33, wherein the condition is a smooth muscle cell-dependent disease.
78. The method of claim 77, wherein the smooth muscle cell-dependent disease is a vascular disease.
79. The method of claim 78, wherein the vascular disease is atherosclerosis.
80. The method of claim 77, wherein the smooth muscle cell-dependent disease is a gastrointestinal disease.
81. The method of claim 80, wherein the gastrointestinal disease is selected from the group consisting of: esophageal dysmotility, inflammatory bowel disease, and scleroderma.
82. The method of claim 77, wherein the smooth muscle cell-dependent disease is a bladder disease.
83. The method of claim 33, wherein the condition is associated with Epstein-Barr virus.
84. The method of claim 83, wherein the condition is

selected from the group consisting of mononucleosis, B cell tumors, Burkitt's lymphoma, and nasopharyngeal carcinoma.

- 5 85. An isolated nucleic acid molecule encoding the protein of claim 1.
86. The nucleic acid molecule of claim 85, wherein the molecule is DNA.
- 10 87. A vector comprising the nucleic acid molecule of claim 85 operably linked to a transcriptional control sequence recognized by a host cell transformed with the vector.
- 15 88. The vector of claim 87, wherein the vector is a plasmid.
- 20 89. A method of identifying an agent capable of inhibiting CD40-mediated intracellular signaling in a cell expressing CD40 on the cell surface, comprising providing the cell with the agent under conditions permitting activation of the cell in the absence of the agent, and determining decreased or absent activation, thereby identifying an agent
- 25 capable of inhibiting CD40-mediated intracellular signaling in a cell expressing CD40 on the cell surface.
- 30 90. The method of claim 89, wherein the activation comprises up-regulation of CD23.
91. The method of claim 89, wherein the conditions permitting activation of the cell comprises
- 35 contacting the cell with CD40 ligand or portion thereof effective to activate the cell.

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